

# Teaching Algebra Online

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The American Center for the Study of Distance Education (ACSDE)

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The Pennsylvania State University

110 Rackley Building

University Park, Pennsylvania 16802-3202, USA

Telephone: +814-863-3764 FAX: +814-865-5878

Web site: <http://www.ed.psu.edu/ACSDE/>

DEOSNEWS Archives list web-site: <http://www.ed.psu.edu/acsde/deos/deosnews.html>

E-mail questions to:

DEOS: [mauri@emoderators.com](mailto:mauri@emoderators.com)

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ACSDE Office: [acsde@psu.edu](mailto:acsde@psu.edu)

Director of ACSDE and Editor of AJDE: Dr. Michael G. Moore

DEOSNEWS Editor: Mauri Collins

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## 11.2 Teaching Algebra Online

## **Editorial**

While I was an undergraduate, in a moment of insanity I registered for a five-week summer session and elected to take both Algebra 101 and Introduction to Statistics-at the same time. I spent eight hours a day doing homework and did minimal maintenance in all other areas of my life. I can't imagine taking algebra in a setting where I couldn't offer to buy a classmate lunch just to have the day's problems explained to me.

The author of this month's article shares with us details of the evolution of an hybrid algebra class, using a minimalist set of tools coupled with the most humane learning experience of all for algebra students-time spent face-to-face with other sufferers.

Mauri Collins

DEOSNEWS Editor

## **Teaching Algebra Online**

Nora Strasser

### **Abstract**

Examining alternative delivery systems for algebra is important for providing adult students with options for completing their degrees. The use of Web sites and Web-based quizzes has proven to be a successful method for teaching algebra to adult students. This article reviews the first implementations of such a course to gain insight into the problems and success of the course.

### **Introduction**

Although mathematics is a difficult subject for many students, several characteristics make it viable for online instruction:

... Mathematics requires the active participation of the student.

... Mathematics is well adapted to self-directed learning.

... Mathematics requires a student to master a topic before proceeding to new topics.

However, other characteristics make mathematics a difficult subject to present online:

... Mathematics is based on symbols.

... Mathematics usually cannot be understood without seeing demonstrations of procedures.

... Reading mathematics does not necessarily generate understanding.

A major goal of this study was to overcome these problems and develop an online mathematics course. The course chosen, entitled *Topics in Algebra*, is part of an adult associate degree program and is offered each semester in a sixteen-week, one-night-per-week format.

While research shows that many courses can be successfully delivered online, algebra is probably one of the most difficult to adapt to online learning due to the wide use of symbols in the equations.

This article describes an attempt to offer an algebra course based on the use of e-mail and Web pages. If this course were to prove successful, other adult populations might benefit from similar distance education classes. Online learning provides the flexibility needed by adult learners (Bates 1997). In fact, online learning can be thought of as being place-and-time independent (Herther 1997). Self-directed study can also help to meet the needs of adult students (Shaw 1998).

## **Course Design**

During the fall of 1998, the Academic Computing department at Friends University suggested that several courses be piloted using different forms of computer-assisted learning. As a part of the pilot project, *Topics in Algebra* was offered entirely online. Because of availability problems on campus, there were some limitations on the types of computer-assisted instruction. Therefore, *Topics of Algebra* employed e-mail as the primary communication method, and quizzes were administered via the Web.

The students were required to attend only three on-campus class sessions during the sixteen-week semester. The first on-campus meeting was designed to orient the students to the tools that would be used in the course. The other two meetings were used for taking the midterm exam and the final exam. We felt that on-campus exams were essential to ensuring the integrity of the course and its participants.

In a traditional classroom-based course, the material might typically be written on a chalkboard during a lecture. In this online course, the lessons were sent to the students as e-mail attachments once a week. The lessons were composed in Microsoft Word 97 because this software has an equation editor that allows equations to be included in the text.

Weekly quizzes were constructed using Asymetrix Toolbook software and administered over the Internet. In order to take a quiz, the students accessed the course's home page. When the students completed a quiz, the quiz was immediately scored, and the score was e-mailed to the instructor.

The instructor's most difficult task was to construct the quizzes because, again, symbols and equations had to be used. The text-entering capabilities of the Asymetrix Toolbook software did not allow equations to be entered directly. The equations were constructed in Microsoft Word, and then pasted into Asymetrix Toolbook. This process required more than 32 meg of computer memory.

To construct Web-based lessons, a combination of software such as Asymetrix Toolbook and an equation editor requires a computer that is fast and has sufficient memory. Our computer had a Pentium II 233 processor with 32 meg of memory. Its speed was adequate for the task but, when Asymetrix Toolbook and the equation editor were both open, the free memory dropped to less than one meg and the system crashed frequently.

## **Results of the Autumn 1998 Course**

Generally, the students were pleased with the course. They liked the flexibility, but agreed that they might have benefited from additional on-campus sessions. The students indicated that these sessions could help them answer questions and bring together the understanding that was needed.

with additional on-campus meetings.

Several students concluded that, although the course was more difficult than a traditional on-campus course, they liked the format. Some students, because of work or other personal commitments, would not have been able to complete the course in a traditional schedule. These students agreed that taking a course online was a necessary option for them, and they appreciated the flexibility. One student commented, "I enjoyed learning on my own and not having to be in class so much."

When the Fall 1998 semester started, sixteen students were enrolled in the course. Shortly afterward, this number was reduced to eleven students. Of the five who withdrew, three did so because they were at an off-site location and did not get the textbook in a timely manner. The other two students who withdrew did not specify a reason. All eleven remaining students successfully completed the course.

Although they performed well on tests, the students expressed uncertainty during the course that they were adequately comprehending the material. We thought that perhaps the students would become more confident

### **Assessment of the Fall 1998 Course**

For the instructor, teaching algebra using this method is time consuming, but rewarding. One major problem was the variety in the computer abilities of the students. Even though extensive computer skills were a prerequisite for enrollment, some students were lacking these skills.

At times, the students encountered technical problems not related to their computer skills. Most technical problems were unique to their computer or system (e.g., insufficient memory). Once these problems were resolved, the course ran smoothly. The largest problems were with taking the quizzes online. However, none of the students had difficulty receiving their lessons via e-mail.

### **Course Revision**

During the summer of 1999, the course was again offered in an online format. Several modifications were incorporated in the course's structure. Whereas the first course used e-mail to distribute lessons, the second course featured a new Web site on which lessons were posted. The students could access the lessons at their convenience and could, in fact, work as far ahead as they wanted.

We used Web Course in a Box to construct the new Web site. The Web site was organized by lessons. These lessons included links to the Microsoft Word lessons, quizzes, and tutorials. The format was a vast improvement over the previous method of dissemination.

This course also featured an increased number of on-campus sessions. The students convened for a total of seven sessions: one for orientation, one for the midterm exam, one for the final exam, and four (held bi-weekly) to review course content and to ask questions.

### **Results of the Summer 1999 Course**

The biggest problem, unexpectedly, involved technical issues. We expected that most technical problems would have been resolved in the previous course. However, just prior to the start of the second course, lightning struck the computer system, causing major, far-reaching problems. The day that the course was scheduled to begin, the system was barely functioning. However, the system was repaired and the course was able to continue. Then, some students began reporting difficulty in accessing the course Web site. We discovered that, in a recent change of Internet service providers for the campus, the URL address for the academic server was omitted.

Finally, after a week and a half, all technical problems were resolved. By that time, most of the students had withdrawn from the course in frustration. Of eighteen students, only five remained. These five students completed the course successfully, with no further technical problems.

### **Assessment of the Summer 1999 Course**

The technical problems that overshadowed the educational quality of the course must be addressed. As a consequence of these problems, another course offering in this format may be in jeopardy. The educational aspects of the course were improved over the initial offering. Most of the students, even those who withdrew, liked the Web Course in a Box format and were impressed with the quality of the materials available.

## **Recommendations**

Students in online or hybrid courses need assurance that technical computing assistance is available twenty-four hours a day, and that any problems will be given top priority. Without these assurances, a bad experience resulting from technical problems may overshadow the educational merits of the course.

It is also important to require a certain level of computer access and software. For example, for this course, students must have access to a Pentium-class computer equipped with Microsoft Word 97 (or a later version). Although the on-campus computer labs were available for the students to take quizzes or receive their lessons, none of the students used the labs. We again emphasize that a good working knowledge and above-average skill level with computers will be required for courses of this type.

Finally, the revisions implemented in the second course were seen as major improvements. The number of on-campus meetings seemed adequate and were appreciated by the students. These revisions should be a part of all future online offerings of this course in this format.

## **Future Plans**

Due to continuing issues with technical support, the online version of this course has not been offered since the summer of 1999. We have examined various alternatives, including using outside support systems and upgrading internal support. A test offering using Academic Systems software was held during the fall of 2000. While this was successful, the in-house structure was a better fit. The internal support structure has been improved, and a new course using the original format is being planned for the fall of 2001.

In this new offering, we plan to use BlackBoard, whose developer has bought Web Course in a Box. However, the basic format for the course will be maintained. The number of on-campus sessions will also remain the same as those used for the summer 1999 offering. The online quizzes will be administered in an essentially unchanged format from the previous offerings.

We plan to implement an increased level of technical support on campus in an effort to prevent the types of problems that occurred previously. Students will be able to seek assistance via a help desk number as well as by e-mail. We still fall short of the ideal of twenty-four-hour assistance, but the support should be far greater than what was available before.

It is important that only students who are proficient with computers be allowed to take the course. During online registration, students will be required to take a computer-proficiency quiz. Only those students who pass this quiz will be allowed to enroll in the online course. The proficiency quiz will be written using the same Toolbook software that was used for other quizzes in the course.

Previously, enrollment was restricted to students on the main campus. The new offering is being planned so that students in all locations will be eligible to enroll, making it a true distance learning and online format course. Some additional problems may occur due to the locations of the students. It is important that students taking the course are aware of the requirements for computer access. Arrangements must also be made to assure that off-site students are able to take exams and benefit from the on-campus meetings. The exams will be administered by the staff at the off-site location. A tutor will be hired to conduct the study sessions that will be held at the off-site locations. The students at off-site locations will not meet directly with the instructor, but with other personnel who will assist them in completing the requirements of the course.

## **Conclusion**

Mathematics courses can be successfully implemented using online learning. As the bounds of technology expand, it should become easier to use alternate modes of instruction for mathematics. If an improved method to put equations into use on the Web becomes widely available, online mathematics courses will be far easier to deliver. It is possible to deliver an algebra course successfully using the Web. As technology improves, mathematics should be better adaptable to online instruction.

## Conclusion

Mathematics courses can be successfully implemented using online learning. As the bounds of technology expand, it should become easier to use alternate modes of instruction for mathematics. If an improved method to put equations into use on the Web becomes widely available, online mathematics courses will be far easier to deliver. It is possible to deliver an algebra course successfully using the Web. As technology improves, mathematics should be better adaptable to online instruction.

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## Author Information

Nora Strasser, Professor of Mathematics and Chairman of the Natural Science and Mathematics Division  
2100 University  
Friends University  
Wichita, KS 67213  
Phone: 316-295-5879  
Fax: 316-295-5404  
E-mail: [strasser@friends.edu](mailto:strasser@friends.edu)